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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/851,313	05/09/2001	Tatsuya Usami	NEC01P069-MSb	2820

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EXAMINER	
MALDONADO, JULIO J	
ART UNIT	PAPER NUMBER
2823	

DATE MAILED: 12/29/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/851,313	USAMI, TATSUYA	
	Examiner	Art Unit	
	Julio J. Maldonado	2823	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *14 November 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,4,5,8,31,32 and 34-52* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,4,5,8,31,32 and 34-52* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *20051121*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 11/14/2005 has been entered.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

3. Claims 1, 4, 5, 8, 31, 34, 35, 37, 38, 41-45, 47-49 and 52 are rejected under 35 U.S.C. 102(e) as being anticipated by Yau et al. (U.S. 6,054,379).

In reference to claims 1, 5, 31, 35, 41, 42, 48, 49 and 52, Yau et al. (Fig.10H) teach a semiconductor device having an interconnect structure including a first insulation layer (710) comprising an organic material having a dielectric constant which is lower than a silicon oxide dielectric constant; a second insulation layer (714, 716, 718) consisting of three layer and including a polysiloxane compound having an Si-H

group and formed on and adhering to a top of said first insulation layer (710); a third insulation layer (722) comprising an inorganic material and formed on and adhering to a top of said second insulation layer (714), the first (710), second (714, 716, 718) and third (722) forming a multi-layered insulation film; and a plurality of wires (724) which are formed in groves formed in said multi-layered insulation film filling a space between said wires (724), wherein said second insulation layer (714, 716, 718) comprises a hydride organosiloxane, and said second insulation layer (714, 716, 718) comprises a layer to improve an adhesion property between said first insulation layer (710) and said third insulation layer (722) (column 13, lines 12 – 663).

However, Yau et al. fail to expressly teach that said product includes a Si-H bond. However, Yau et al. teach an interconnect structure including a dielectric adhesive layer formed in a plasma reactor. This compound is the product of organosilicon compounds having the structure $SiH_a(CH_3)_b(C_2H_5)_c(C_6H_5)_d$, where a=1 to 3, b=0 to 3, c=0 to 3 and a+b+c+d=4, and oxidizing compounds such as N_2O and O_2 (Yau et al., column 4, lines 32 – 63). Yau et al. also teach using CH_3-SiH_3 as a preferred organosilicon compound. Taking this into consideration, and for purposes of providing support, Schmitt et al. to U.S. 2005/0233591 A1 teach an interconnect structure including a dielectric adhesive layer formed in a plasma reactor using reactants such as CH_3-SiH_3, and $(CH_3)_2$-SiH_2, for example, and oxidizing compounds such as N_2O and O_2, wherein said product can include CH_3-SiH_2-O- groups and $(CH_3)_2$-SiH-O- groups. (Schmitt et al., [0027] – [0033]). Since the same materials are treated

the same way, the same product is obtained, and Yau et al. teach upon the claimed limitation.

In reference to claims 4 and 8, Yau et al. teach wherein said third insulation layer comprises at least one material selected from the group including silicon oxide (column 13, lines 19 – 22).

In reference to claims 34 and 47, Yau et al. teach wherein said first insulation layer comprises a thickness greater than a thickness of said second insulation layer; and wherein said first insulation layer can have a thickness greater than a thickness of said third insulation layer (column 13, lines 12 – 22).

In reference to claim 37, Yau et al. teach wherein a bottom of said groove is formed on a same surface as said first insulation layer (Fig.10H).

In reference to claim 38, Yau et al. teach wherein said plurality of wires comprises copper wires (column 13, lines 47 – 63).

In reference to claim 43, Yau et al. teach wherein said first insulation layer, said second insulation layer and said third insulation layer of said multi-layered insulation film comprise substantially uniform widths (Fig.10H).

In reference to claim 44, Yau et al. teach wherein a surface of said multi-layered film is substantially coplanar with a surface of said plurality of wires (Fig.10H).

In reference to claim 45, Yau et al. teach wherein said second insulation layer is formed by plasma CVD (column 4, line 19 – column 5, line 19).

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 32, 36, 50 and 51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yau et al. (U.S. 6,054,379) as applied to claims 1, 4, 5, 8, 31, 34, 35, 37, 38, 41-45, 47-49 and 52 above, and further in view of The Applicants Admitted Prior Art.

Yau et al. substantially teaches all aspects of the invention including a first dielectric layer such as parylene, FSG, silicon oxide, or the like (Yau et al., column 13, lines 12 – 16) and wherein metal lines can be included on the substrate wherein said first dielectric layer covers a space between said metal lines (Yau et al., column 10, line 18 – column 11, line 43), but fails to disclose wherein dielectric layer is an organopolysiloxane including methyl silsesquioxane (MSQ) and wherein said wires connect a plurality of gate electrodes formed on said substrate with an upper level in the device, said first insulation layer formed on and between said gate electrodes, wherein said plurality of wires comprises a contact which contacts a diffusion region formed in said substrate between said plurality of gate regions, wherein a spaced formed between adjacent gate electrodes in said plurality of gate electrodes is filled with said first insulation layer and wherein a spaced formed between adjacent gate electrodes in said plurality of gate electrodes filled with said first insulation layer. However, the prior art

(Instant Figs.8a-9b) teaches a device having a plurality of gate electrodes (60) having diffusion regions (54) formed on a substrate (51); and a first insulation layer (55) over said substrate (51) having a wiring connection between the gate electrodes through a diffusion region (54) locates between said gate electrodes (60), wherein said first insulation layer includes methyl silsesquioxane, and wherein said wiring connects said gate electrodes to an upper level (Instant page 2, lines 5 – 8 and page 5, lines 9 – 24). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Yau et al. with the teachings of the prior art to substitute the dielectric material taught by Yau et al. for the SOG material disclosed by the prior art because using MSQ reduces crosstalk between metal wires (Instant page 2, lines 12 – 15) and because the selection of a known material based on its suitability for its intended use supported a prima facie obviousness. MPEP 2144.07. It would also have been obvious to one of ordinary skill in the art to combine the teachings of Yau et al. and the prior art to substitute the metal lines of Yau et al. with the electrodes disclosed in the prior art to arrive at the claimed invention.

6. Claims 39, 40 and 46 are rejected under 35 U.S.C. 103(a) as being unpatentable over Yau et al. (U.S. 6,054,379) as applied to claims 1, 4, 5, 8, 31, 34, 35, 37, 38, 41-45, 47-49 and 52 above, and further in view of Allada et al. (6,218,317 B1) alone or in combination with Chen et al. (Effects of slurry formulations on chemical-mechanical polishing of low dielectric constant polysiloxanes: hydrido-organo siloxane and methyl silsesquioxane).

Yau et al. substantially teach all aspects of the invention but fail to disclose wherein said second insulation layer comprises methylated hydrogen silsesquioxane film (MHSQ) at a thickness of about 50 nm, wherein said dielectric layer includes repeating units of $(SiCH_3O_2)_n$, $(SiO_2H)_n$ and $(SiO_3)_n$, wherein a molar ratio of $(SiO_2H)_n$ to a total of said repeating units is at least 0.2. However, Allada et al. (Figs.1a-1b) in a related art to the formation of copper interconnect structures teach a second insulating film comprising a methylated hydrido organo siloxane polymer (HOSP), wherein said polymer can be formed by spin coating processes or by conventional CVD processes (column 2, lines 7 – 67).

Furthermore, according to Chen (Fig.1), methylated hydrido organo siloxane polymer (HOSP) includes repeating units of $(SiCH_3O_2)_n$, $(SiO_2H)_n$ and $(SiO_3)_n$, wherein a molar ratio of $(SiO_2H)_n$ to a total of said repeating units is at least 0.2.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use the insulating layer as taught by Allada et al. in the interconnect formation structure of Yau et al., since this dielectric layers exhibit low dielectric constants and also have better adhesion properties than conventional dielectric layers (Allada et al., column 1, lines 37 – 60 and column 2, lines 36-48). The combined teachings of Yau et al. and Allada et al. fail to teach wherein said MHSQ film comprises a thickness of about 50 nm. Notwithstanding, it would have been an obvious matter of design choice bounded by well known manufacturing constraints and ascertainable by routine experimentation and optimization to choose these particular dimensions because applicant has not disclosed that the dimensions are for a particular

unobvious purpose, produce an unexpected result, or are otherwise critical, and it appears prima facie that the process would possess utility using another dimension. Indeed, it has been held that mere dimensional limitations are prima facie obvious absent a disclosure that the limitations are for a particular unobvious purpose, produce an unexpected result, or are otherwise critical. See, for example, In re Rose, 220 F.2d 459, 105 USPQ 237 (CCPA 1955); In re Rinehart, 531 F.2d 1048, 189 USPQ 143 (CCPA 1976); Gardner v. TEC Systems, Inc., 725 F.2d 1338, 220 USPQ 777 (Fed. Cir. 1984), cert. denied, 469 U.S. 830, 225 USPQ 232 (1984); In re Dailey, 357 F.2d 669, 149 USPQ 47 (CCPA 1966).

Response to Arguments

Applicant's arguments filed 11/14/2005 have been fully considered but they are not persuasive.

Applicant argues, "...in the claimed invention the second insulation layer includes a polysiloxane compound having an Si-H group and formed on and adhering to a top of the organosiloxane film of the first insulation layer...this feature if not taught or suggested by Yau...". In response to this argument, Yau et al. teach an interconnect structure including a dielectric adhesive layer formed in a plasma reactor. This compound is the product of organosilicon compounds having the structure $SiH_a(CH_3)_b(C_2H_5)_c(C_6H_5)_d$, where a=1 to 3, b=0 to 3, c=0 to 3 and a+b+c+d=4, and oxidizing compounds such as N_2O and O_2 (column 4, lines 32 – 63). Yau et al. also teach using CH_3-SiH_3 as a preferred organosilicon compound. However, Yau et al. fail to expressly teach that said product includes a Si-H bond. Nevertheless, and for

purposes of providing support, Schmitt et al. to U.S. 2005/0233591 A1 teach an interconnect structure including a dielectric adhesive layer formed in a plasma reactor using reactants such as CH_3-SiH_3, and $(CH_3)_2$-SiH_2, for example, and oxidizing compounds such as N_2O and O_2, wherein said product can include CH_3-SiH_2-O- groups and $(CH_3)_2$-SiH-O- groups. (Schmitt et al., [0027] – [0033]). Since the same materials are treated the same way, the same product is obtained, and Yau et al. teach upon the claimed limitation.

Also, Applicant argues, "... Yau teaches that the organosiloxane film of the first insulation layer would adhere well to the inorganic material in the third insulation layer. Thus, Yau would have no reason to form a second insulation layer to improve adhesion between the organosiloxane film and the third insulation layer...". In response to this argument, and as mentioned hereinabove, Yau et al. teach an interconnect structure having a first organic dielectric layer, the second insulation layer, which is an adhesion layer, and a third insulation layer as claimed.

Applicant also argues, "...there is no motivation or suggestion in the references (Yau et al. in view of Applicants' Admitted Prior Art) to urge the combination as alleged by the Examiner...". In response to applicant's argument that there is no suggestion to combine the references, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir.

1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, Yau et al. teach an interconnect structure including a first dielectric layer made of parylene, FSG, or the like (column 13, lines 12 – 28). Furthermore, the prior art teaches dielectric layers used for interconnect structures include MSQ (Instant page 2, lines 5 – 8 and page 5, lines 9 – 24). Therefore, as mentioned in the rejection mailed in 07/11/2005, it would have been obvious to one of ordinary skill in the art at the time the invention was made to combine the teachings of Yau et al. with the teachings of the prior art to substitute the dielectric material taught by Yau et al. for the SOG material disclosed by the prior art because using MSQ reduces crosstalk between metal wires (Instant page 2, lines 12 – 15) and because the selection of a known material based on its suitability for its intended use supported a prima facie obviousness. MPEP 2144.07

Furthermore, Applicant argues, "...there is no motivation or suggestion in the references (Yau et al. in view of Aoi) to urge the combination as alleged by the Examiner...". In response to this argument, and as mentioned above, the examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988)and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992). In this case, as well as in the previous example, Yau et al. teach an interconnect structure including a first dielectric layer made of parylene, FSG, or the like (column 13, lines 12 – 28). Furthermore, Aoi (Figs.4a-11c) teaches a

multilayered insulation film having wiring embedded therein, wherein interlayer insulation layer (204) comprises any arbitrary material such as fluorinated polyimide and polyaryl ether (column 10, lines 1 – 11). Therefore, It would have been within the scope of one of ordinary skill in the art to combine the teachings of Yau et al. with the teachings of Aoi to enable using the dielectric materials of Aoi in Yau et al. because one of ordinary skill in the art at the time the invention was made would have been led to the conclusion that the selection of known materials based on its suitability for its intended use supported a prima facie obviousness. MPEP 2144.07.

In reference to the combination of Yau et al., Allada et al. and Chen et al., Applicant argues, "...these reference would not have been combined and even if combined, the combination would not teach or suggest each and every element of the claimed invention. In contrast to Yau, Allada is intended to address the problems involved with forming an undoped silicon glass (USG) hardmask on a polymer-insulated material without taking out a wafer from a spin-truck device, by producing multilayered wired in which both the hardmask and a layered insulation material are capable of being spin-coated. Moreover, in complete contrast to Yau and Allada, Chen is intended to provide a method for chemically and mechanically controlling the chemical mechanical polishing (CMP) characteristics of polysiloxanes which have low dielectric constants...". In response to this argument, Allada et al. was relied on Allada et al. was relied on teaching a second insulating film comprising a methylated hydrido organo siloxane polymer (HOSP), wherein said polymer can be formed by spin coating processes or by conventional CVD processes (column 2, lines 7 – 67) for the further advantage of better

adhesion properties than conventional dielectric layers (Allada et al., column 1, lines 37 – 60 and column 2, lines 36-48). Chen et al. was relied for support. Specifically, according to Chen (Fig.1), methylated hydrido organo siloxane polymer (HOSP) includes repeating units of $(SiCH_3O_2)_n$, $(SiO_2H)_n$ and $(SiO_3)_n$, wherein a molar ratio of $(SiO_2H)_n$ to a total of said repeating units is at least 0.2.

Conclusion

7. Applicants are encouraged, where appropriate, to check Patent Application Information Retrieval (PAIR) (http://portal.uspto.gov/external/portal/pair) which provides applicants direct secure access to their own patent application status information, as well as to general patent information publicly available.

8. Any inquiry concerning this communication or earlier communications from the examiner should be directed to examiner Julio J. Maldonado whose telephone number is (571) 272-1864. The examiner can normally be reached on Monday through Friday.

9. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew Smith, can be reached on (571) 272-1907. The fax number for this group is 571-273-8300. Updates can be found at http://www.uspto.gov/web/info/2800.htm.

Julio J. Maldonado
Patent Examiner
Art Unit 2823

Julio J. Maldonado
December 27, 2005

George Fourson
Primary Examiner